Claims

1. An optical device comprising an encoding surface having a micro-relief pattern over at least part thereof designed to produce a predetermined diffracted first image when illuminated in use, and an optically anisotropic layer provided whereby at least part of said micro-relief pattern induces local orientation of said optically anisotropic layer thereby to impose a predetermined polarization modulation, thereby to produce a predetermined second image when illuminated in use.

2. An optical device according to Claim 1, wherein said micro-relief pattern is provided on a layer in contact with said optically anisotropic layer thereby to define said encoding surface.

3. An optical device according to Claim 1, wherein said encoding surface is formed on the optically anisotropic layer.

4. An optical device according to any of the preceding Claims, wherein said encoding surface includes one or more relatively strongly diffractive regions having a significant diffractive effect and one or more relatively weakly diffractive regions where there is little or no diffractive effect.

5. An optical device as claimed in any of the preceding Claims, wherein said encoding surface includes a plurality of areas, each of which having a respective orientation of the micro-relief pattern thereon, defining respective optical axes of the optically anisotropic layer.

6. An optical device according to any of the preceding Claims, wherein the coating thickness of at least part of the optically anisotropic layer is

selected having regard to the frequency of the intended illumination in use, to provide a ½ λ phase retardation when appropriately viewed.

7. An optical device according to any of Claims 1 to 3, wherein the coating thickness of at least part of the optically anisotropic layer is selected having regard to the frequency, of the intended illumination in use, to provide a ¼ λ phase retardation when appropriately viewed.

8. An optical device according to any of the preceding Claims, wherein at least one of:

the average thickness of the optically anisotropic layer, and

its birefringence

varies with position across said device to vary the optical retardation induced thereby.

9. An optical device according to any of the preceding Claims wherein the encoding surface is stepped, whereby the thickness of the optically anisotropic layer is stepped by a step distance which is substantially greater than the structure pitch dimension, thereby to provide regions of respective selected retardations.

10. An optical device according to Claim 8, wherein the thickness of said optically anisotropic layer, disregarding the micro-relief pattern is generally continuously contoured.

11. An optical device according to Claim 10, wherein the thickness of said optically anisotropic material, disregarding the micro-relief pattern, varies linearly in at least one dimension.

12. An optical device according to any of the preceding Claims, wherein the encoding surface is reflective over at least part of the device, whereby at least part of said device is adapted to operate in reflection mode.

13. An optical device according to any of the preceding Claims, wherein at least part of the surface of the optically anisotropic layer remote from the encoding surface is at least partially reflective.

14. An optical device according to Claim 2, wherein the micro-relief layer comprises a transmissive substrate and at least part of the surface thereof remote from the interface with the optically anisotropic layer is reflective.

15. An optical device according to any of the preceding Claims, adapted to operate in use in transmission mode.

16. An optical device according to any of the preceding Claims, adapted to operate in use in reflection mode.

17. An optical device according to any of the preceding Claims, wherein said optically anisotropic layer comprises a polymerisable liquid crystalline material.

18. An optical device according to any of the preceding Claims, wherein said optically anisotropic layer comprises a polymer liquid crystal material.

19. An optical device according to any of the preceding Claims, wherein the orientation of said optically anisotropic layer is permanently preserved by a fixing process.

20. An optical device according to Claim 2 and any claim dependent

thereon, wherein the refractive index of the micro-relief layer is substantially equal to the ordinary or extraordinary refractive index of the optically anisotropic layer.

21. A method of producing an optical device which comprises providing an encoding surface having a micro-relief pattern over at least part thereof designed to provide a predetermined diffracted first image when illuminated in use, and providing an optically anisotropic layer wherein at least part of said micro-relief pattern induces local orientation of said optically anisotropic layer thereby to impose a predetermined polarization modulation thereby to produce a predetermined second image when illuminated in use.

22. A method according to Claim 21, which includes providing a micro-relief layer and applying said layer of optically anisotropic material thereto thereby to define said encoding surface.

23. A method according to Claim 21 or Claim 22, wherein said micro-relief pattern is formed by embossing.

24. A method according to Claim 21 or Claim 22, wherein said micro-relief pattern is formed by UV curing of a suitable material in contact with a master.

25. A security device including an optical device according to any of Claims 1 to 19.

26. A bank note including an optical device according to any of Claims 1 to 19.

27. A security document including an optical device according to any

of Claims 1 to 19.

28. An Identification Card including an optical device according to any of Claims 1 to 19.

29. A container including an optical device according to any of Claims 1 to 19.

30. Packaging including an optical device according to any of Claims 1 to 19.

31. A data storage device including an optical device according to any of Claims 1 to 19.

32. A method of authentication of an article or substance, which comprises applying to said article or substance an optical device in accordance with any of Claims 1 to 19, and thereafter examining said article or substance for the presence of at least one of said first and second images.